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EXAMINER

WAI, ERIC CHARLES

ART UNIT	PAPER NUMBER
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2195

NOTIFICATION DATE	DELIVERY MODE
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12/03/2009

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 10/676,922	Applicant(s) LOWELL, DAVID E.	
	Examiner ERIC C. WAI	Art Unit 2195	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 July 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 2-4, 6-28, 30, 32, 33, 35-46, 48-50, 52-54, 56-64 and 66 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 2-4, 6-28, 30, 32, 33, 35-46, 48-50, 52-54, 56-64 and 66 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>10/21/2009</u> . | 6) <input type="checkbox"/> Other: _____ |

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DETAILED ACTION

1. Claims 2-4, 6-28, 30, 32-33, 35-46, 48-50, 52-54, 56-64, and 66 are presented for examination.

Double Patenting

2. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

3. Claims 2-4, 6-28, 30, 32-33, 35-46, 48-50, 52-54, 56-64, and 66 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-67 of copending Application No. 10/677,159. Although the conflicting claims are not identical, they are not patentably distinct from each other. For example, claim 11 of the present application recites, “a method comprising to

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commence virtualization of the I/O device at runtime". Claim 1 of copending Application No. '159 recites "the method comprising commencing virtualization of the memory at runtime". It would have been obvious to one of ordinary skill in the art that an I/O device can be a memory.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

4. Claims 2-4, 6-28, 30, 32-33, 35-46, 48-50, 52-54, 56-64, and 66 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-72 of copending Application No. 10/676,557. Although the conflicting claims are not identical, they are not patentably distinct from each other. For example, claim 11 of the present application recites, "a method comprising to commence virtualization of the I/O device at runtime". Claim 1 of copending Application No. '557 recites "the method comprising interposing the virtual machine monitor between the computer and the operating system at runtime". It would have been obvious to one of ordinary skill in the art that interposing the virtual machine monitor at runtime is equivalent to commencing virtualization using a virtual machine.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 8, 10, 15, 17-19, 27-28, 38, 45-46, 56-54, 64 and 66 are rejected under 35 U.S.C. 102(e) as being anticipated by Le et al. (US Pat No. 7,082,598).

6. Regarding claim 15, Le teaches in a computer including an I/O device, a method comprising:

using a virtual machine monitor to commence virtualization of the I/O device at runtime (col 34 lines 39-55, wherein a driver is installed to allow the VMM to process I/O requests, i.e. the installed driver allows the device to become virtualized), wherein runtime is a period of execution in the computer after boot and before shutdown of the computers (col 31 lines 39-40, wherein drivers are substituted during runtime), wherein the I/O device has multiple modes of operations (col 34 lines 62-63, wherein the agent may utilize different drivers depending on the mode of operation);

the virtual machine monitor determines the mode of the I/O device prior to commencing the virtualization (col 34 lines 62-66, wherein it is inherent that the VMM detects the normal driver in order to perform the switching); and

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the virtual machine monitor restoring the determined mode of the operation after the virtualization (col 34 lines 64 to col 35 line 11, wherein a switch to the normal driver can be made to restore the operation of the device for non-virtualized software components).

7. Regarding claim 8, Le teaches that the virtual machine monitor can commence the emulation between I/O sequences (col 31 lines 48-55).

8. Regarding claim 10, Le teaches that the virtual machine monitor can commence the emulation in the middle of an I/O sequence (col 31 lines 48-55).

9. Regarding claim 17, Le teaches in a computer including hardware, a method comprising:

running a virtual machine monitor on the hardware (col 33 lines 46-49);
running an operating system on the virtual machine monitor (col 33 lines 50-60),
wherein the hardware includes an I/O device, and the I/O device is already virtualized by the virtual machine monitor (col 34 lines 39-55, wherein a driver is installed to process I/O requests); and

devirtualizing the I/O device at runtime, wherein runtime is a period of execution in the computer after boot and before shutdown of the computer (col 34 lines 62 to col 35 line 11, wherein the agent can switch between drivers for the device (i.e. devirtualizing the device) so that the “non-virtualized” side of the system can still

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perform I/O requests; col 31 lines 39-55, wherein driver substitution can be performed dynamically, wherein driver substitution can be turned on and off at will (i.e. virtualizing and devirtualizing the device)).

10. Regarding claim 18, Le teaches that the devirtualization is performed transparently to the operating system (col 31 lines 59-67).

11. Regarding claim 19, Le teaches that the devirtualization includes stopping I/O device emulation at runtime (col 31 lines 39-55, wherein the turning off the driver substitution would result in stopping the device emulation).

12. Regarding claim 27, Le teaches wherein the I/O device has multiple modes of operations (col 34 lines 62-63, wherein the agent may utilize different drivers depending on the mode of operation); the method further comprising;

the virtual machine monitor determining the mode of the I/O device prior to commencing the devirtualization (col 34 lines 62-66, wherein it is inherent that the VMM detects the normal driver in order to perform the switching); and

the virtual machine monitor restoring the determined mode of the operation after the devirtualization (col 34 lines 64 to col 35 line 11, wherein a switch to the normal driver can be made to restore the operation of the device for non-virtualized software components).

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13. Regarding claim 28, Le teaches that the I/O device is virtualized at runtime again after having been devirtualized at runtime (col 31 lines 39-55, wherein driver substitution can be performed dynamically, wherein driver substitution can be turned on and off at will (i.e. virtualizing and devirtualizing the device).

14. Regarding claims 38, and 45-46, they are computer system claims of claims 17, and 27-28 above. Therefore, they are rejected for the same reasons as claims 17, and 27-28 above.

15. Regarding claims 56-54, 64 and 66, they are article claims of claims 17, 19, and 27-28 above. Therefore, they are rejected for the same reasons as claims 17, 19, and 27-28 above.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

16. Claims 9, 20-24, 39-43, and 58-62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Le et al. (US Pat No. 7,082,598).

17. Regarding claim 9, Le teaches that the virtual machine monitor commences emulation by intercepting I/O accesses (col 34 lines 39-42).

18. Le does not teach that the virtual machine monitor uses the intercepted I/O accesses to change the state of a state machine, whereby the state machine reflects the state of the I/O device; and wherein the virtual machine monitor examines transitions in the state of the state machine to determine whether the I/O device is in the middle of an I/O sequence.

19. It would have been obvious to one of ordinary skill in the art at the time of the invention to include the use of a state machine. One would be motivated by the desire to have a method of representing the state of the I/O device to track its operation.

20. Regarding claim 20, Le does not teach that the devirtualization includes allowing the virtual machine monitor to temporarily stop the operating system from commencing a new I/O sequence.

21. It would have been obvious to one of ordinary skill in the art at the time of the invention to include temporarily stopping the OS from commencing a new I/O sequence. One would be motivated by the desire to ensure complete devirtualization before processing a new I/O request.

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22. Regarding claim 21, Le does not teach that the virtual machine monitor temporarily stops the operating system by emulating the I/O device as being in a "busy" or "device not ready" state.

23. It would have been obvious to one of ordinary skill in the art at the time of the invention that the VMM would emulate the I/O device as being in a busy or unready state. Le teaches that the VMM operates transparently from the guest OS. Therefore, one would be motivated by the desire to ensure that the OS does not error out by indicating to the OS that the device is busy in order to stop further I/O requests.

24. Regarding claim 22, Le does not teach that the virtual machine monitor bounds the amount of time the operating system processing is temporarily stopped.

25. It would have been obvious to one of ordinary skill in the art at the time of the invention that the VMM bound the amount of time that the OS is stopped. One would be motivated by the desire to ensure that the OS not be stopped indefinitely.

26. Regarding claim 23, Le does not teach that the VMM logs I/O accesses by the operating system to the I/O device during devirtualization, and replays the log to the device after devirtualization, whereby the I/O accesses by the operating system are deferred during the devirtualization of the I/O device.

27. It would have been obvious to one of ordinary skill in the art at the time of the invention to that some sort of logging and playback must occur when the device is

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devirtualized. One would be motivated by the desire to track any requests that may occur during devirtualization.

28. Regarding claim 24, Le does not teach that the virtual machine monitor waits for I/Os initiated by the virtual machine monitor's driver for the I/O device to complete, and for all expected interrupts from the device to arrive, before ceasing device emulation.

29. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Le to wait for I/Os initiation by the virtual machine monitor's driver for the I/O device to complete, and for all expected interrupts from the device to arrive, before ceasing device emulation. One would be motivated by the desire to ensure that all interrupts directed to the VMM are completed before transferring control.

30. Regarding claims 39-43, they are computer system claims of claims 20-24 above. Therefore, they are rejected for the same reasons as claims 20-24 above.

31. Regarding claims 58-62, they are article claims of claims 20-24 above. Therefore, they are rejected for the same reasons as claims 20-24 above.

32. Claims 25-26, 44, and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Le et al. (US Pat No. 7,082,598) in view of Nelson et al. (US Pat No. 6,961,941).

33. Regarding claim 25, Le does not teach re-directing interrupts from interrupt handlers in the virtual machine monitor to interrupt handlers in the operating system.

34. Nelson teaches that an unloading procedure that involves restoring interrupt and fault handling processing (col 5 line 20). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Le to explicitly teach restoring the interrupt handles during de-virtualization. One would be motivated by the desire to restore the system back to its previous state.

35. Regarding claim 26, Le teaches not teach configuring the hardware so the accesses by the operating system to the I/O device no longer trap to the virtual machine monitor.

36. Nelson teaches that an unloading procedure that involves restoring interrupt and fault handling processing (col 5 lines 18-25). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Le to explicitly teach no longer trapping I/O accesses. One would be motivated by the desire to restore the system back to its previous state.

37. Regarding claim 44 and 63, they are the computer and article claims of claim 26 above. Therefore, they are rejected for the same reasons as claim 26 above.

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38. Claims 2-4, 6-7, 11-14, 16, 30, 32-33, 35-37, 48-50, and 52-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nelson et al. (US Pat No. 6,961,941) in view of Duvall et al. (US Pat No. 4,742,447).

39. Regarding claim 11, Nelson teaches in a computer including an I/O device (col 3 line 29), a method comprising using a virtual machine monitor to commence virtualization of the I/O device at runtime, wherein runtime is a period of execution in the computer after boot and before shutdown of the computer (col 3 lines 5-16, 29-40, 48-53, wherein after a commodity operating system (COS) is first loaded and initialized, *then* a kernel containing the VMM is then loaded (i.e. at runtime) via the COS; “after *initialization* of the computer, a list of devices *initially* controlled by the COS is preferably transferred from the COS to the kernel”, i.e. the device is virtualized).

40. Nelson does not explicitly teach that the virtual machine monitor determines whether the I/O device is performing an I/O sequence, and delays commencing the virtualization until the virtual machine monitor determines that the I/O sequence has completed.

41. However, it is old and well known to not interrupt an I/O operation until it has completed. For example, Duvall teaches waiting for an I/O request to complete before resolving a page fault (col 12 lines 29-34). It would have been obvious to one of ordinary skill in the art at the time of the invention to try modifying Nelson to teach waiting for an I/O operation to complete before virtualizing the I/O device. One would be motivated by the desire to not interrupt an I/O operation before it has completed.

42. Regarding claim 2, Nelson teaches that the computer further includes a CPU (col 1 lines 52-54), wherein the virtual machine monitor is in control of the CPU prior to the runtime virtualization of the I/O device (col 3 lines 29-40, wherein the kernel must be in control of the CPU in order to virtualize the device).

43. Regarding claim 3, Nelson teaches that the virtualization is performed transparently to the operating system (col 1 lines 38-41).

44. Regarding claim 4, Nelson teaches that the I/O device is compatible with the virtualized I/O device (col 1 lines 38-51, wherein they must be compatible in order for the virtualization to be transparent).

45. Regarding claim 6, Nelson teaches configuring the hardware to trap I/O accesses, and enabling the virtual machine monitor to emulate the I/O device in response to the traps (col 3 lines 37-40, wherein the VMM must trap I/O access to emulate delivery of the interrupt; wherein interrupts are generated by I/O devices).

46. Regarding claim 7, Nelson teaches that the virtual machine monitor uses memory management to trap the I/O accesses (col 4 lines 20-22).

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47. Regarding claim 12, Nelson teaches that the runtime virtualization includes using the virtual machine monitor to emulate I/O device interrupts (col 3 lines 44-47, wherein interrupts are masked; wherein interrupts are generated by I/O devices).

48. Regarding claim 13, Nelson teaches that the I/O device interrupts are directed to the operating system prior to the runtime virtualization of the I/O device (col 3 lines 29-31, wherein the devices are initially controlled by the COS before being transferred to the kernel).

49. Regarding claim 14, Nelson teaches that the virtual machine monitor temporarily pauses an I/O sequence by emulating the I/O device as being busy (col 3 lines 41-43, wherein interrupts are delayed).

50. Regarding claim 16, Nelson teaches devirtualizing the I/O device at runtime following the runtime virtualization (col 5 lines 22-25).

51. Regarding claims 30, 32-33, and 35-37, they are computer system claims of claims 4, 6-7, 11-12, and 14 above. Therefore, they are rejected for the same reasons as claims 4, 6-7, 11-12, and 14 above.

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52. Regarding claims 48-50, and 52-54, they are article claims of claims 4, 6-7, 11-12, and 14 above. Therefore, they are rejected for the same reasons as claims 4, 6-7, 11-12, and 14 above.

Response to Arguments

53. Applicant's arguments with respect to claims 2-4, 6-28, 30, 32-33, 35-46, 48-50, 52-54, 56-64, and 66 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

54. aApplicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

55. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric C. Wai whose telephone number is 571-270-1012.

The examiner can normally be reached on Mon-Thurs, 8am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng - Ai An can be reached on 571-272-3756. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Meng-Ai An/
Supervisory Patent Examiner, Art Unit 2195

/Eric C Wai/
Examiner, Art Unit 2195